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Letter dated 9 February 1999 from the Permanent Representative of Germany to the United Nations addressed to the Secretary-General

I have the honour to transmit to you the report of the Chairman of the International Cooperative Programme on the Assessment and Monitoring of Air Pollution Effects on Forests.*

I would be grateful if the text of the present letter and its annex could be distributed as an official document of the third session of the Intergovernmental Forum on Forests, which will take place at Geneva from 3 to 13 May 1999.

(*Signed*) Dieter **Kastrup**

* The report is circulated in the language of submission.

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International Co-operative Programme on the Assessment and Monitoring of Air Pollution Effects on Forests

In cooperation with the

European Union Scheme on the Protection of Forests against Atmospheric Pollution

Chairman's report to the 3rd meeting of the Intergovernmental Forum on Forests (IFF) in May 1999

Impact of Air Pollutants on Forests

(Chapter I, sub-paragraph E of the report of the Intergovernmental Panel on Forests dated 3/20/1997)

I. Summary

The observation of forest decline notably in Central Europe caused great concern in the early '80s about the detoriation of forests throughout Europe and led to an increasing awareness of the environmental, economic, cultural and social values of forests. As a consequence the International Cooperative Programme on the Assessment and Monitoring of Air Pollution Effects on Forests (ICP Forests) was mandated in 1986 to monitor air pollution effects on forests and to contribute to a better understanding of cause-effect relationships. Two monitoring levels (including crown condition assessments, soil and foliar analyses, increment studies, deposition and meteorological measurements and ground vegetation assessments) have been established to reach the above mentioned objectives.

More than 10 years of large scale crown condition assessments have revealed an overall deterioration of forest health in Europe. For the period from 1988 to 1997 , the number of damaged trees shows a relative increase among the twelve more important forest tree species. Today roughly one in four sample trees lost at least 25% of their needles/ leaves compared to healthy trees in the same region.

Forest damage can be explained as a complex interaction of many natural influencing factors such as insects, fungi, extreme weather conditions. Biotic agents with temporal and regional variations lead to fluctuations in the health status of trees. However, the important role of air pollution in this context is supported by results of more symptom-specific studies on injury from air pollution. More than half of the European countries involved in the ICP Forests work consider air pollution as a predisposing, accompanying and locally triggering factor for forest damage.

The clean air measures which have already been carried out at national and international levels are expected to lead to a further decrease in pollutant emissions and to an improvement of forest condition. On a whole, however, deposition measurements show that at present there are still too many examples of pollutants being deposited into forest ecosystems exceeding the critical levels and loads. Therefore the consequent continuation of emission reduction will be of high priority in future in order to improve forest condition in Europe.

Keywords: Forest condition, monitoring network, abatement strategies

II. Introduction

In response to the increasing concern about forest damage caused by transboundary air pollution the United Nations Economic Commission for Europe launched the International Co-operative Programme on the Assessment and Monitoring of Air Pollution Effects on Forests (ICP Forests) in 1985. Under German chairmanship and in close cooperation with the European Union (EU) the ICP Forests surveys the condition of forests using harmonised methods in meanwhile 34 European states (UN/ECE, 1998a).

An extensive monitoring approach (Level I) is aimed at securing findings on modifications of forest condition at European level as well as on the impact of pollutants including air pollutants. A transnational network (16 x 16 km) of around 5,700 plots constitutes the backbone of this approach. The monitoring activities within this network include annual crown condition surveys as well as soil condition surveys and chemical element analyses of foliage. In addition, each year all 34 states survey crown conditions in the framework of national surveys in mostly more densely networks than the 16 x 16 km grid with up to around 33,000 plots.

An intensive monitoring approach (Level II) is being pursued on 760 permanent tree plots in 30 states. In addition to annual crown condition surveys, soil condition surveys and foliage analyses, it includes measuring deposition, analysing tree growth, surveying ground vegetation, measuring meteorological conditions and analysing soil solution.

Each year, the main findings of the joint European forest condition survey are documented (UN/ECE and EC, 1998b)

III. Results

According to the 1997 crown condition survey, one out of four European trees can be considered „damaged" (loss of foliage >25%). Meteorological effects (drought, heat and frost) and biotic pests (insects and fungi) are considered to be the main causes for defoliation

On the basis of the results of forest damage research at national level numerous countries generally attribute to atmospheric pollutants a predisposing and locally even damaging factor. Some results of the forest condition survey carried out at international level, point to atmospheric pollutants as being part of the cause complex, too (UN/ECE and EC, 1998b).

In large parts of Europe, defoliation oscillates around a long-term average, which can be put down to natural influences. The most important tree species, however, have shown a considerable increase in defoliation for more than a decade in many regions, which can hardly be explained by invoking natural stress factors. This defoliation development differs according to regions and tree

species. Though the regional comparability of survey results is somewhat restricted, it is obvious that defoliation is highest in some regions of Central Europe. These most damaged areas have the highest deposition rates for sulphur, nitrogen and heavy metals in Europe. Until a couple of years ago, in these areas the condition of crowns, in particular those of conifers (spruce and pine), worsened considerably. Recently, there was some regeneration in some areas, notably for pines, but partly also for deciduous trees (beech and oak). This regeneration is partly explained by more favourable weather conditions and partly by the emission reduction in recent years. In other regions, namely in parts of Western and South Eastern Europe, a particular deterioration of the crown condition of broadleaves was observed in recent years.

There is no doubt that the crown condition is an important indicator of the trees' vitality, as it visibly reacts to quite a number of environmental factors. At the same time, however, this results in a low specificity of the crown condition as a diagnostic mark. The inclusion of the results of the soil analyses and the foliage analyses will facilitate a more holistic assessment of the forest condition.

The evaluation of the soil condition data shows the different degrees of acidity (pH values) in the different European forests' mineral topsoils. In Northern, Western and Central Europe there are many acidic topsoils (pH < 3.5). In Central and Eastern Europe extremely acidic topsoils (pH < 3.0) can be found. The trees on this soil face an increased risk of root damage and of nutritional disorders. In regions with high nitrogen depositions the nitrogen content in the organic soil layer is correspondingly high. On 15 to 20% of the plots, the C/N ratio, which is important for forest nutrition, is lower in the humus layer than on mineral soil. Concentrations of certain heavy metals in the humus layer, in particular of lead and zinc, reflect the regional air pollution situation.

The results of the chemical element analyses of foliage at Levels I and II indicate a satisfactory nutrition status for most trees. Only 10% of all plots demonstrably had particularly low calcium, magnesium and potassium concentrations. In Central Europe and in the United Kingdom, high concentrations of sulphur and nitrogen were found in foliage, in particular in regions with high deposition of these elements. Although sulphur concentrations in Scots pine needles were generally low, they were high in German, Slovakian and United Kingdom forests with high levels of sulphur depositions. The highest nitrogen concentrations were found in beech leaves at German and UK locations with high levels of nitrogen.

The results of the Level I forest condition survey have basically been substantiated by first data evaluations of Level II permanent tree plots.

IV. Causes for forest damage

There are quite a number of indicators in the forest condition survey which support the widely recognized hypothesis that the severe damage to forests in many parts of Central Europe is primarily to be blamed on the high level of pollutant depositions in these countries. In other European regions where there is less atmospheric pollution, forest conditions vary on condition of many natural and anthropogenic (i.e. man-made) influences. The responsibility of air pollutants for the cause complex varies considerably according to the location.

In order to answer the question to what extent air pollutants have an impact on the forest condition at European level, more detailed research on ecological processes on Level II plots is necessary. The next step should be to extrapolate the processes identified on small areas to the whole of Europe with the help of Level I data. This way, the two stages of monitoring intensity – Level I and Level II - are going to be inextricably linked.

V. Strategies for Forest Protection

Taking air pollution as a predisposing, accompanying and locally triggering factor for forest damage the reduction of pollutants is one of the main keys to protect European forests.

At international level it is important to implement the existing internationally binding instruments notably those under the Convention on Long-Range Transboundary Air Pollution. Since its entry into force in 1983, the Convention has been extended by specific protocols such as the *Protocol on the Reduction of Sulphur Emissions or their transboundary fluxes* by at least 30% compared to 1980 (1985, revised in 1994) and the *Protocols concerning the Control of Emissions of Nitrogen Oxides (1988) and of Volatile Organic Compounds* (1991). A *protocol on the reduction of POP and Heavy Metals* as well as the second *Protocol on the Control of Emissions of Nitrogen Oxides* were adopted 1998. Highest priority will be given in the coming years to implement the various protocols.

While sulphur emissions have been reduced in nearly all European countries, nitrogen emissions have increased significantly in many of these countries. Controlling the sources of nitrogen has therefore become even more important. The development of effect based abatement strategies at a regional level was an substantial step forward taking into account the critical level and load concept as an essential tool.

Many European countries have committed themselves in addition to these international efforts to reduce their emissions by even higher percentages than internationally agreed. The Member States

of the European Union for example will reduce their sulphur dioxide emissions by the year 2000 by 65% compared to 1980.

This effect oriented approach will continue to need information on the recent status and trends in forest condition and thus monitoring activities of ICP Forests and EU will remain of high importance. In addition to these clean-air measures most European countries are promoting forestry measures (such as e.g. soil protection liming, reafforestation with trees adapted to the site) designed to increase the resistance of their forests to harmful influences. Interdisciplinary forest research will continue to be supported as an indispensable condition for further clarifying cause-effect relationships of forest damage.

VI. Literature

UN/ECE, 1998a: Manual on Methodologies and Criteria for Harmonized Sampling, Assessment, Monitoring and Analysis of the Effects of Air Pollution on Forests. 4th edition. Hamburg.

UN/ECE and EC, 1998b: Forest Condition in Europe – Executive Report 1998. Geneva and Brussels, 37 pages.